

An Investigation into Predictors of Competitive Success
in a Large-Scale Group Foraging Task

By

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Abstract

Ideal Free Distribution Theory (IFD) (Fretwell & Lucas, 1970) suggests that the allocation of organisms to two or more resource sites is a function of the available resources at each site.

Experimental arrangements involving human participants consist of a series of trials in which participants choose between two resource sites with differing resource values. Past research has investigated the relationship between delay discounting and performance in an IFD task, noting correlations between higher discounting and poorer individual performance. The current study sought to investigate the predictive capabilities of various psychological assessments, including an individual and group-context delay discounting task. Results demonstrate that the allocation of participants conformed to the IFD theory. Additionally, results suggest that, while controlling for all other assessments, the individual delay discounting assessment, competitive index score, and proportion of trials switched significantly predicted performance.

Keywords: delay discounting, group context delay discounting, ideal free distribution theory, competitive success

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As a quantitative model of choice (Herrnstein, 1961), the matching law states that the relative proportion of responses towards an alternative is equal to (i.e., matches) the relative proportion of reinforcement available for that alternative. Typically, matching is assessed by presenting two concurrently available response alternatives, each corresponding to a different variable interval schedule of reinforcement. All behaving is choice, in that at any instance an organism may continue to engage in a response or begin engaging in a number of different responses (Herrnstein, 1970). Put simply, the paradigm is representative of the choices that organisms continuously encounter. The matching law predicts that the relative rate of reinforcement for a given choice alternative dictates the response allocation of an organism, where

$$\frac{R_1}{R_2} = \frac{B_1}{B_2} \quad \text{Equation 1}$$

R_1 and R_2 refer to the relative rate of reinforcement, and B_1 and B_2 refer to the relative response rates.

Baum (1974) provided a generalized equation of the matching law that accounts for the sensitivity to reinforcement of the organism and whether there are biases in the organism's responding. Quantitatively, the generalized matching equation is expressed as

$$\log\left(\frac{B_1}{B_2}\right) = s \log\left(\frac{R_1}{R_2}\right) + \log(b) \quad \text{Equation 2}$$

where B refers to the response alternatives and R refers to the available reinforcement for each alternative. Sensitivity, or s , refers to the degree to which an organism allocates its behavior to a reinforcing choice alternative that is accounted for by reinforcement. Perfect matching, as denoted by $s=1.00$, states that an organism's allocation of behavior perfectly matches the

available reinforcement for each reinforcing alternative. For instance, in a concurrent choice arrangement, perfect matching would suggest that twice the behavior would be allocated to the choice alternative that has twice the available reinforcement. Undermatching, as denoted by $s < 1.00$, suggests that less behavior would be allocated to the response alternative than is predicted by the matching law. Conversely, overmatching, as denoted by $s > 1.00$, suggests that more behavior would be allocated to the response alternative than predicted by the matching law. Lastly, bias (b) refers to any preferences for a response alternative that is unaccounted for by reinforcement. A positive bias refers to a preference towards the response alternative associated with the numerator of the response portion of equation 2 that is unaccounted by reinforcement, while a negative bias indicates a preference towards the denominator that is unaccounted by reinforcement.

The matching law has been applied to understand the behavioral allocation of a diverse range of behaviors including sports (e.g., Alferink, Critchfield, Hitt, & Higgins, 2009; Reed, Critchfield, & Martens, 2006), academics (e.g., Reed & Martens, 2008), and social dynamics (e.g., Borrero, Crisolo, Tu, Rieland, Ross, Francisco, & Yamamoto, 2007). Although the matching law has been helpful in understanding the distribution of an individual's behavior in a variety of contexts, recently, ecological biology has been applied to understand the distribution of organisms operating within a group, known as the Ideal Free Distribution (IFD) theory.

The IFD theory (Fretwell & Lucas, 1970) is an extension of the matching law that accounts for the behavior of organisms operating in a group setting, and suggests that the allocation of organisms to two or more resource sites is a function of the available resources at those sites. There are distinct similarities between both the qualitative and quantitative aspects of the matching law and the IFD theory. First, the dependent variable in a matching law paradigm is

an organism's behavior, while the dependent variable in an IFD paradigm is the number of organisms. Instead of manipulating the relative rate of reinforcement (i.e., matching law) for the two different response alternatives, the typical IFD paradigm involves the manipulation of the relative amount of resources available at the two different resource sites. Lastly, the quantitative models are represented by the same equation; instead of the proportion of behavior as a function of reinforcement, it is the proportion of organisms as a function of the available resources.

Quantitatively, its simplest form states that the proportion of individuals at a resource site is equal to the proportion of available resources (Baum & Kraft, 1998):

$$\frac{N_1}{N_2} = \frac{A_1}{A_2} \quad \text{Equation 3}$$

where N refers to the number of individuals at a resource site, and A refers to the available resources. Therefore, it is predicted that if there are twice as many resources available at site one than site two, there will be twice as many organisms at site one than site two. This result of perfectly equal proportion of individuals to resources is referred to as *habitat matching* (Pulliam & Caraco, 1984). As with the matching law, however, there are often deviations from habitat matching. That is, the perfect distribution of organisms to available resources rarely occurs, resulting in a need for a generalized version of the equation to account for the deviations from the IFD theory. In 1987, Fagan modified the generalized matching equation to account for groups of organisms (cf., Baum, 1974; equation 2):

$$\log\left(\frac{N_1}{N_2}\right) = s \log\left(\frac{A_1}{A_2}\right) + \log(b) \quad \text{Equation 4}$$

In the generalized ideal free distribution model, N refers to the number of individuals at a resource site. A refers to the amount of resources available at each site. The value, s , refers to the sensitivity to differences in the amount of resources available in each resource site. Lastly, b

refers to the group bias that influences the relative allocation of organisms to each resource site. A potential bias, for instance, could be the presence of a predator at a resource site.

Perfect matching, or habitat matching, is represented by $s=1$. Undermatching (i.e., $s < 1.00$) refers to a situation in which the number of individuals at a resource site is less extreme than what is predicted based on the amount of available resources. . That is, there are less individuals at the resource site than predicted by equation one. Conversely, when there are more organisms at a resource site than predicted by equation one, the pattern of responding is referred to as overmatching (i.e., $s > 1.00$). Undermatching is the most common finding in the literature, with an average s value of 0.70 across a wide range of species (Kennedy & Gray, 1993). These data suggest organisms are typically less sensitive to resource allocations than is predicted by the IFD theory.

Initial investigations of the IFD theory originated in ecological and biological research aimed at assessing the relative distribution of non-human animals towards two or more resource sites in contrived and natural environments (e.g., Milinski, 1984; Harper, 1982; Abrahams, 1989), concluding that IFD theory predicted the distribution of organisms. As one example, Harper (1982) manipulated the availability of resources (i.e., pieces of white bread) for a group of mallard ducks in their natural habitat (i.e., a pond). Both the rate at which resources were presented and the amount of resources presented (i.e., weight of bread) were manipulated, finding that the distribution of ducks closely approximated the predictions based on the IFD theory.

Although IFD has been experimentally studied with non-humans, there have been relatively few investigations into the IFD of humans (e.g., Kraft & Baum, 2001; Kraft, Baum, & Burge, 2002; Sokolowski, Tonneau, & Baque, 1999; Madden et al., 2002; Critchfield &

Atteberry, 2003). Despite the lack of research, the initial data provide support of the IFD theory for humans in both experimental and natural settings.

In a typical human operant IFD arrangement, participants are instructed to make choices between two resource sites differing in the amount or rate of rewards provided. There are numerous experimental manipulations which result in different levels of conformity to the predicted distribution of individuals, including the ability to switch resource sites after seeing how many individuals are in each site, the ability to communicate (i.e, verbal behavior), and whether it is a discrete trial or free operant arrangement. Participants are told that they are to compete for limited resources (i.e., hypothetical points that are typically exchangeable for monetary rewards or extra credit) by making a series of choices between one of two resource sites, in which they evenly split the resources with however many individuals are at each resource site. Each choice is a trial, and there are typically 15-20 trials per condition. Each condition is associated with a constant rate or amount of rewards for each site, with most experiments employing four to six conditions (including a direct replication condition).

In 1999, Sokolowski et al. conducted the first experimental investigation of the distribution of human participants between two resource sites. Each resource site had a specific number of token rewards that were available, and these rewards were evenly split between the number of individuals that were at the resource site. The participant that had the most tokens was awarded a cash prize for each condition. The ratio of available tokens for each resource site was manipulated between each condition. The results of the experiment demonstrated conformity to the ideal free distribution theory, with undermatching patterns of distribution being observed ($s=0.67$).

Madden et al. (2002) conducted a series of three experiments investigating various procedures used to assess the ideal free distribution theory. In all three experiments, 12 undergraduate students served as participants. Participants were instructed to make a series of choices between two resource sites of varying undisclosed point values that would be evenly split between each other individual in that resource site, and were told that they were to try and earn as many points as they could. In the first experiment, a systematic replication of Kraft and Baum (2001), participants were instructed to make a choice between red or blue (i.e., each resource site), and could then freely switch between resource sites. The second experiment followed the same procedure as experiment one, but participants were unable to switch after their initial choice and they were instructed not to talk. This was done to ensure that participants made decisions based on their own judgements, rather than on what others said. In the third experiment, rewards were delivered on concurrent variable time schedules. In this free operant arrangement, participants were able to freely walk between resource sites. The first two experiments consisted of 5 conditions, each consisting of 20 trials. In the third experiment, each of the five conditions consisted of at least 20 minutes of responding and when the behavior of the group was deemed stable.

The results from experiment one of Madden et al. (2002) show undermatching for both initial and final choices, with the final choice distribution of responses ($s=0.92$) much closer to ideal matching than initial selections ($s=0.40$), and virtually no bias for either the initial or final selection. Unsurprisingly, these data suggest initial selections were less sensitive to the available resources than the final selections, as participants were able to adapt their choices following initial selections to adapt to the distribution of individuals at a given resource site.

The Madden et al. (2002) manuscript noted that participants communicated—thus, they may have strategized—in the first experiment. Therefore, experiment two investigated the IFD theory without being able to communicate or freely switch between resource sites following their initial selections. Results from experiment two demonstrated undermatching ($s=0.82$) taken from the final six trials of each condition (i.e., stability criteria). Interestingly, as a novel analysis, the probability of switching as a function of the points earned on a previous trial was plotted for each condition. Analysis indicated participants were a) more likely to switch after low point earnings (i.e., 6-8 points), b) would likely stay at the resource site for medium point earnings (i.e., 10-18 points), and c) would be more likely to switch after big-win point earnings (i.e., 20+ points).

Madden et al. (2002) data suggest the orderly relation between group allocation and available resources in a discrete trial format. However, the authors noted that a free operant format, in which organisms are able to freely travel between each resource site, is more analogous to the natural environment. Therefore, experiment three employed a free operant paradigm in which two response alternatives (i.e., two sides of a room) were programmed to deliver rewards on concurrently available variable time schedules of reinforcement. Results from experiment three demonstrated a correspondence between the predicted allocation of individuals (i.e., predicted by the IFD theory) and the obtained number of participants at each resource site. These data lend support to the predictive utility of the IFD theory. Additionally, results of the final 5-minutes of each condition (i.e., stability criteria) demonstrated undermatching ($s=0.71$).

During group foraging tasks, there is variability between participants in regards to competitive success. Critchfield & Atteberry (2003) suggested that an individual's sensitivity to delays may account for the variability in these tasks. Conceptually, individuals that are relatively sensitive to delays (i.e., self-controlled) may be more likely to sample the rich resource site,

switch less often, and earn more overall points. Put simply, individuals that respond in more self-controlled patterns might be expected to demonstrate more competitive success than individuals that are relatively insensitive to delays (i.e., impulsive). To assess sensitivity to delays, Critchfield & Atteberry (2003) employed a delay discounting assessment in conjunction with a group foraging task.

Delay discounting refers to the decline in value of a reward based on the delay to which that reward is received (Odum, 2011). In a typical human operant delay discounting procedure, the participant is provided with a series of dichotomous choices between a smaller hypothetical rewards delivered immediately versus larger hypothetical rewards delivered after some delay. Preference for the smaller reward across trials is representative of impulsive choice, while preference towards the larger yet delayed reward across trials is representative of self-controlled choice. Steep rates of discounting (i.e., a pattern of responding towards smaller-immediately available rewards) has been associated with maladaptive behaviors including obesity, gambling, and substance abuse (Epstein, Salvy, Carr, Dearing, & Bickel, 2010; Reynolds, 2006).

Critchfield and Atteberry (2003) investigated the relation between delay discounting and performance in an IFD activity with college undergraduates in a human operant arrangement. The rationale for their study was based upon past literature that noted the relationship between discounting and sensitivity to reinforcement (Critchfield & Atteberry, 2003), as well as differences in the rates of discounting that were correlated with prevalence or intensity of impulsive choices (Critchfield & Kollins, 2001). Participants completed a six-page paper-pencil delay discounting assessment, in which participants made a series of dichotomous choices between \$1000 received after a delay, or a smaller amount available now. The initial choice was between \$1000 delivered after a delay and \$500 delivered immediately. If the participant

selected the larger-delayed reward, the smaller amount decreased on the subsequent trial. Conversely, if the participant selected the smaller amount, the smaller amount increased on the subsequent trial. The delay was manipulated across each page (i.e., condition), and consisted of a 1 month, 6 month, 1 year, 3 years, 5 years, and 10 year delays. All rewards and delays were hypothetical.

Participants in the Critchfield and Atteberry (2003) study were unsystematically assigned to one of 17 groups, each consisting of 9-12 individuals, to participate in the group foraging task (i.e., IFD paradigm). Each participant was provided with both a red and a blue card used for responding during the task, each colored card corresponding with a resource site. Participants were instructed to raise either the blue or red card to make a choice. Participants were then told that they would be responding to earn hypothetical points exchangeable for extra credit, with the points being split evenly between the other participants that were at the same resource site. For instance, if there were 100 points available for selecting the red resource site, and if 10 individuals selected red, they would each split the 100 points for a total of 10 points each. The participants were not told how many points each resource site was worth. Each group completed 4 conditions, with each condition containing 16 trials.

Critchfield and Atteberry (2003) hypothesized that participants demonstrating steeper rates of discounting (i.e., a relative preference towards smaller-immediately available rewards) would be (a) more likely to sample the lean resource site, (b) less likely to switch resource sites, and (c) earn less overall points (i.e., perform worse in the group foraging task).

Critchfield and Atteberry's (2003) results demonstrated undermatching across the majority of groups, with group slopes ranging from $s=0.36-1.30$ (median $s=0.72$). Switch point probability as a function of relative point gain was consistent with the results of Madden et al.

(2002), in that individuals were likely to switch with low relative point earnings, likely to stay with medium relative point earnings, and there was a slight increase in switch probability at relatively high point earnings. Additionally, results suggest a slight difference between the most and least impulsive individuals, as determined by temporal discounting rates, with the most impulsive individuals having less pronounced (i.e., less extreme) switch probabilities. Although there were substantially different results for individuals in relation to competitive success (i.e., rich patch choices, number of switches, frequency of better outcomes, and total point earnings), a correlational analysis suggested that temporal discounting accounted for a significant proportion of the variance in the data. There were significantly negative correlations between discounting rates and log rich/lean choices, log better/worse choices, and total points earned, while there were significant correlations between the number of switches and discounting rates in both studies. Simply put, steeper discounters tended to choose the lean resource site more often, select the worse option more often, switch more often, and earn fewer overall points.

The IFD theory provides an experimental and conceptual framework that has potential applied relevance. The allocation of individuals as a function of the available resources has been observed in naturalistic environments, suggesting that environments may be contrived to manipulate the relative distribution of individuals. For instance, in one demonstration of the distribution of humans in an undisturbed natural environment, Disma, Sokolowski, and Tonneau (2011) observed the distribution of children in Istanbul, Turkey, in relation to the available resources (i.e., high traffic areas in which the children could sell water bottles). They found that the IFD theory was predictive of the proportion of children towards the available resource sites. Put simply, the proportion of children at each intersection matched the proportion of cars at those intersections. In this sense, the manipulation of the available resource sites (e.g., location of site,

rate of available resources, the amount of available resources) may result in changes in the proportion of individuals at each resource site. The manipulation of these variables could influence issues of societal importance by changing the distribution of individuals to areas that are more socially appropriate. For instance, social cohesion (i.e., cooperation between groups of people from diverse backgrounds) could be enhanced by increasing the available resources in areas that supports these interactions (e.g., community centers, parks).

Past research has looked at social engagement (Borrero, Crisolo, Tu, Rieland, Ross, Francisco, & Yamamoto, 2007; Conger & Killeen, 1974; McDowell & Caron, 2010; McDowell & Caron, 2010), but these analyses have only been useful for engagement between two people. Despite this, it is important to look at group cohesion. Psychological assessments, including social discounting measures (Charlton, Yi, Porter, Carter, Bickel, & Rachlin, 2013) and Social Value Orientation (Van Lange, Otten, De Bruin, Joireman, 1997), have been used to investigate the relative variables that contribute to group cohesion. These assessments are easy to administer in an online survey format, and provide an assessment of an individual's preference for outcomes that are face valid in comparison to a group foraging task (e.g., competition, social dynamics). Similar to other behavioral indicators of cooperation (see Hursh and Roma, 2013), IFD can provide a quantitative application to group cohesion.

The purpose of the current study is to systematically extend the previous research by Critchfield and Atteberry (2003) by assessing the predictive utility of three different empirically validated assessments (i.e., delay discounting, social value orientation, competitiveness index) in comparison with performance on a group foraging task. Additionally, in an effort to improve the novel discounting assessment in Critchfield and Atteberry (2003), the current study employed empirically validated delay discounting assessments. Furthermore, Critchfield and Atteberry

(2003) only assessed individual discounting, while the current study investigated both individual (Kirby, Petry, & Bickel, 1999) and group-context delay discounting (Charlton et al., 2013). Lastly, a recent experimental investigation (i.e., Sokolowski, Tonneau, & Cordevant, 2015) demonstrated the use of a video game-based data collection tool, finding orderly relations between available resources and the distribution of individuals responding. Despite this demonstration, the current study provided potential improvements by employing a novel data collection tool that allows for automated data collection, live feedback for participants, and can support 150+ participants in a single experimental session.

Methods

Online Survey

Participants

160 undergraduate students (138 women, 20 men, 1 prefer not to disclose, 1 gender non-conforming) enrolled in an introductory behavioral science course at a large Midwestern university served as participants, ranging in age from 19 to 45 years old ($M = 21.05$, $SD = 3.29$). Participant's received 0.5% extra credit towards their overall grade in the course for the completion of the online survey. The research procedures were approved by the University of Kansas' Human Subjects Committee (HSCL #00002182).

Materials and Procedure

Participants were notified via email and an in-class announcement about the availability of the online survey. The survey, generated via Qualtrics online survey database, was available for 11 days (March 24th to April 3rd, 2015) and required approximately 15 minutes to complete. The online survey consisted of demographics, an individual (Kirby et al., 1999) and group context delay discounting assessment (Charlton et al., 2013), a Social Value Orientation assessment (Van Lange et al., 1997), and the Revised Competitiveness Index (Houston, Harris, McIntire, & Francis, 2002).

The survey began with an informed consent page (see appendix A) and demographic questions (e.g., age, gender). Following the completion of the demographic questions, participants were randomly and evenly assigned to both the individual or group context delay discounting assessment. After completing each of these discounting assessments, participants were randomly assigned to the Social Value Orientation and the Competitiveness Index that were evenly counterbalanced to mitigate order effects. Lastly, participants were required to type in

their unique iClicker ID number, allowing the experimenter to match their online survey responses with their performance in an in-class group foraging task.

Multiple-choice Questionnaire:

The individual delay discounting assessment was adapted from the 27-item Kirby delay discounting assessment (Kirby et al., 1999), and consisted of 27 questions regarding decisions between smaller-immediate hypothetical monetary amounts and larger hypothetical monetary amounts delivered after a specified delay that benefits the responding individual (see appendix C). The following assumption was provided prior to the administration of the individual delay discounting:

“For each of the next 27 choices, please mark which hypothetical reward you would prefer: the smaller reward today, or the larger reward in the specified number of days. While you will not actually receive the rewards, pretend you will actually be receiving the amount you indicate and answer honestly.”

The group-context delay discounting assessment (Charlton et al., 2013) followed the same format (i.e., same delays and monetary amounts), however, the choices were presented as benefiting the responding individual and 9 other students enrolled in the Introduction to Applied Behavioral Science course (see appendix D). Participants were provided with the following assumption:

“Imagine you must make decisions that affect you and 9 other classmates in ABSC 100. For each of the next 27 choices, please mark which hypothetical reward you would prefer: the smaller reward today, or the larger reward in the specified number of days. However, the choices that you will make will benefit you and 9 other classmates in ABSC 100. While neither you nor each of the classmates will not actually receive the rewards, pretend that you all will actually be receiving the amount you indicate and answer honestly as if the rewards were real.”

The Social Value Orientation assessment consisted of a 9-item trichotomous choice paradigm assessing an individual’s prosocial, individualistic, and competitiveness orientations (Van Lange et al., 1997; see appendix E). Participants were presented with three options in which they

selected hypothetical outcomes for themselves and an unknown stranger. Participants were provided with an assumption regarding the task, provided below.

“In this task we ask you to imagine that you have been randomly paired with another person, whom we will refer to simply as the "Other." This other person is someone you do not know and that you will not knowingly meet in the future. Both you and the "Other" person will be making choices by selecting either the letter A, B, or C. Your own choices will produce points for both yourself and the "Other" person. Likewise, the other's choice will produce points for him/her and for you. Every point has a value: the more points you receive, the better for you, and the more points the "Other" receives, the better for him/her.

Here's an example of how this task works:

	A	B	C
You get:	480	540	480
Other gets:	80	280	480

In this example, if you chose A you would receive 480 points and the other would receive 80 points; if you chose B, you would receive 540 points and the other 280; and if you chose C, you would receive 480 points and the other 480. So, you see that your choice influences both the number of points you receive and the number of points the other receives. Before you begin making choices, please keep in mind that there are no right or wrong answers - choose the option that you, for whatever reason, prefer most. Also, remember that the points have value: The more of them you accumulate, the better for you. Likewise, from the "other's" point of view, the more points s/he accumulates, the better for him/her.”

Participants’ pattern of choices was classified as one of three categories. Prosocial involves taking a lesser value of points thereby providing the “other” individual with an equal amount of points (i.e., choice C in the provided assumptions). Competitive involves taking a lesser amount of points thereby providing the “other” individual with a very small amount of points (i.e., choice A). Lastly, individualistic involves taking the highest amount of points, thereby providing the “other” individual with a medium amount of points (i.e., choice B). If more than four responses were for a single pattern of responding (e.g., 5 responses in the prosocial category), the individual responded in ways that are designated as social orientation.

The Revised Competitiveness Index consists of 14-items divided into two subscales; enjoyment of competition and contentiousness (Houston et al., 2002; see appendix F), in which participants rated themselves on a five-point Likert scale.

Group foraging task

Participants

One week after the online survey was made available, students in the Introduction to Applied Behavioral Science course were allowed to participate in an optional in-class extra credit opportunity that took place in their normal classroom during a regularly scheduled class period. 154 participants completed the in-class portion of the study. Demographic data were not taken, although participants provided their unique iClicker IDs following the completion of the in-class study, allowing the researcher to compare results obtained from the in-class portion with the online survey portion. The amount of extra credit that participants earned was determined by their performance in the group foraging task and is shown in Table 1. Performance was based upon the amount of accrued hypothetical points during the task.

Materials and Setting

The group foraging task took place in a large, 272 seat lecture hall with stadium-style seating. Each participant sat facing three large screens that displayed relevant information. Participants were instructed to bring their iClicker 2s (<https://www.iclicker.com/>; see appendix G), a remote device that is used for live quiz responding during the regularly scheduled class periods. Each iClicker has a power key, arrows for selecting various options, and 5 response keys (A-E). For the purpose of the group foraging task, participants were instructed to power on their iClickers and only respond using either the “A” or “B” response keys. The iClickers were synced with the computer in the classroom, allowing for automated data collection. Each participant was

provided with the information statement (see Appendix A), instructions, and a data collection sheet (see Appendix H) for each condition (six) to record their point earnings for each trial.

Two undergraduate research assistants provided inter-observer agreement during data collection. One research assistant sat next to the researcher and recorded the number of individuals that chose either option “A” or “B” during the task on an Excel spreadsheet. The Excel spreadsheet was programmed to calculate the point values that the participants earned after each trial, by dividing the number of people selecting each option by the pre-determined condition values. The condition point values can be found in Table 2. This research assistant helped ensure the accuracy of data by checking that the number of responses on the clicker software matched what the researcher entered in the feedback spreadsheet. If any errors occurred, the research assistant was trained to fix these issues before the feedback was presented to the participants. Despite this, there were no reported errors, and the procedures went according to plan. The second research assistant helped ensure fidelity by blacking out the trial screens while providing feedback (i.e., the number of points and individuals at each resource site). The primary investigator recorded any errors in procedural fidelity, however, there were no errors in feedback delivery.

Procedure

Participants were instructed to read through the information statement prior to the study. Following the information statement, the instructions were displayed on the middle screen at the front of the lecture hall, and the instructions were read aloud to the participants (see below).

“We are interested in how people make choices and decisions. Today, you will make a series of choices using your iClickers. You will be able to freely choose and change your responses within each trial, but when the trial ends, you must record your choice by circling either “A” or “B” in the resource selection column on your data sheet. Following this, you will record the number of points that you earned on that trial, as well as the number of people in each resource site. This information will be provided to you after

every choice trial. There will be 6 conditions with 15 trials each, totaling 90 trials. Your task is to earn as many points as you can, which will then be calculated into extra credit. There will be a certain amount of points delivered for each resource site after each trial. These points will be divided equally between each person in the zone. For example, if there are 5 people in zone “A” and there is 1 point available, then each person in the zone will be rewarded (1/5) or .2 points. There will be many choices today, so it is up to you how to respond. If you falsify your records to try to earn more points, you will receive a score of zero for this task. Yet, if you record your responses accurately, you will receive an additional 0.1% extra credit added to your overall final grade. Finally, once the task begins, there is no talking allowed. If you are being disruptive during this task, we will respectfully ask you to leave the classroom. This is done to ensure that your choice responses are based on your own judgments, rather than based on what others say. If you have any clarifying questions, now is the time to ask them. We will not answer questions or comments during the task.”

After reading the instructional statement, participants were led through two practice trials to help participants understand the task. Participants were instructed to make a choice between resource sites “A” or “B”, and were told that they had 15 seconds before the trial ended. Immediately after this trial, the experimenter provided feedback to the participants via an Excel spreadsheet on the screen for the current trial. The information provided consisted of the number of people in each resource site (A or B), as well as how many points were earned per person for A and B. Participants were then instructed that they had 15 seconds to record this information on their data sheets. The purpose of self-recorded data sheets were a) to help promote attending to the task, b) to provide an additional layer of feedback, and c) to provide an additional measure of data reliability (in addition to the iClicker software and excel spreadsheet).

As per Madden et al.’s (2002) experiment two, participants were not allowed to talk. Two research assistants monitored the class to ensure there were no distractions or interruptions.

The experiment began following the completion of the practice trials. Participants completed 15 trials per condition, with feedback provided after each trial. Additionally, live feedback regarding the number of individuals at each resource site was provided via the iClicker software during each trial (see appendix K). Participant distribution was presented as a bar graph

during the live feedback within each trial, with live adjustments automatically made as participants selected or switched resource sites. Each trial took roughly 15-seconds to collect responses, and roughly 15-seconds to provide feedback. Following the completion of the condition (i.e., 15 trials), a condition change slide was presented and read aloud (see appendix J). The condition change slide stated that “The number of points allocated to ‘A’ and ‘B’ has now changed. It is up to you to determine the best way to earn points”. This process continued until all 6 conditions (90 trials) were completed. Following the completion of the 90 trials, participants were required to turn in their paper-pencil data sheets to the research assistants and were allowed to leave the classroom.

Results

Delay Discounting

Delay discounting results were obtained for 160 participants. Figure 1 shows the natural log transformed k -values for small, medium, and large hypothetical monetary magnitudes for both individual and group context delay discounting assessments. The individual MCQ delay discounting values were natural log transformed and show a mean small k -value of -3.5646 ($SEM=.1200$), a mean medium k -value of -4.2374 ($SEM=.1290$), and a mean large k -value of -4.7083 ($SEM=.1293$). Additionally, for the group-context natural log transformed delay discounting values, the average small k -value of -3.7940 ($SEM=.1305$), the average medium k -value of -4.3597 ($SEM=.1263$), and the mean large k -value of -4.7312 ($SEM=.1366$). Individual MCQ discounting natural log transformed values ranged from -8.74034 to -1.38629, with an average k -value of -4.13943 (see figure 2 for the distribution of natural log transformed k -values). Group discounting natural log transformed values ranged from -8.74034 to -1.38629, with an average k -value of -4.27381. Individual delay discounting and group context delay

discounting were compared using a 2 (condition) x 3 (magnitude) repeated-measures ANOVA. These analyses demonstrated a significant main effect of magnitude ($F(2, 318) = 141.3$, $p < .0001$), a non-significant main effect of condition ($F(1, 159) = 2.584$, $p = .1099$), and a non-significant interaction ($F(2, 318) = 2.335$, $p = .0985$). Overall consistency scores for the individual discounting assessment was 96.13%, while the group delay discounting consistency scores were 95.81%.

Competitiveness and Social Values Orientation

Competitiveness scores were obtained for 159 participants, with an average competitiveness score of 45.95 ($SEM=0.716$). The maximum competitiveness score of a participant was 67, while the minimum score was 15. Social Value Orientation assessments were completed by 160 participants. Participants were scored into four different categories based on their pattern of responding: Competitive, individualistic, prosocial, or mixed. There were 71 participants that were categorized as prosocial, 57 categorized as individualistic, 24 categorized as competitive, and 8 categorized as mixed.

Group Foraging

Of the 154 participants that completed the in-class group foraging task, data were analyzed for 147 participants due to missing data (i.e., no responses). Figure 3 shows group foraging data for each condition. The number of people that selected resource site “A” is presented across each trial in the group foraging task. As the trials progressed across all 6 conditions, the number of individuals stabilized near the predicted level of distribution based on the IFD theory.

The relative proportion of individuals choosing resource site “A” vs. resource site “B” as a function of the relative proportion of points available at resource site “A” and “B” is

represented in Figure 4. The left panel indicates the average distribution of individuals across all conditions for the first 5 trials ($y=.5872x+.0606$, $r^2=.9590$), the middle panel represents the average distribution of individuals across all conditions for the middle 5 trials ($y=.8599x-.0040$, $r^2=.9970$), and the right panel represents the average distribution of individuals across all conditions for the last 5 trials ($y=.9626x+.0049$, $r^2=.9993$). Each data point is representative of one condition, totaling 6 data points per trial block (i.e., five conditions plus one direct replication condition). To assess whether there was a difference between the first five, middle five, and last five trials in the group matching plot, a comparison was conducted between a free y-intercept and shared yet constrained y-intercept. Constraining a shared y-intercept between the three regression lines showed significantly different slopes $F(2,14)=28.94$, $p<.0001$. Additionally, while allowing a non-constrained y-intercept for the three regression lines, the slopes were found to be significantly different $F(2,12)=25.65$, $p<.0001$.

Figure 5 shows the average number of individuals observed in resource site “A” across the last five trials of each condition were plotted as a function of the predicted number of individuals based on the ideal free distribution equation (see equation 3). Linear functions accounted for 99.91% of the variance in the data, with a best fit line of $y=0.973x + 2.472$.

Figure 6 shows the probability of switching resource sites, defined as the proportion of individuals that switched resource sites as a function of the proportion of points earned on the previous trial. The x-axis represents the log-transformed proportion of points earned on the selected resource site compared to the points earned in the other resource site. The y-axis depicts probability of switching. Each data point represents an instance in which a point value was provided and at least one person switched.

Correlations between individual discounting, group discounting, competitiveness assessment, Social Value Orientation, and performance on the group foraging task (i.e., total points earned, number of switches) are compared in Table 3. There was a statistically significant relationship between individual and group discounting ($r(159) = 0.710, p < .001$), and individual discounting and total points earned ($r(159) = 0.186, p < .05$). There were no other statistically significant relationships between these metrics.

Predictive Utility

Table 4 shows results from a multiple regression analysis assessing the predictive utility of the psychological and behavioral independent variables that were assessed (i.e., individual delay discounting, group context delay discounting, competitiveness index, SVO) on the dependent variable of total points earned. Since the purpose of the current study was to assess competitive success, the dependent variable of total points was selected. Results indicated that, in combination, the proportion of trials switched ($\beta = -6.366, t(152) = -3.177, p = .002$), individual delay discounting ($\beta = -0.450, t(152) = -2.152, p = .034$), and the competitiveness index ($\beta = .053, t(152) = 2.301, p = .023$) were statistically significantly predictive, while controlling for all other variables.

Discussion

Delay Discounting

Overall, there was a magnitude effect for both individual and group-context delay discounting that significantly differed between magnitudes (i.e., small, medium, large). There were no condition differences observed between the individual and group context delay discounting assessments, despite condition differences in past research (e.g., Bickel, Jarmolowicz, Mueller, Franck, Carrin, and Gatchalian, 2012). However, there may be limitations

in the current study that could account for the inconsistencies in these findings. One potential explanation could be that the social distance of the group in Bickel et al.'s (2012) study was greater than in the current study. In this sense, the student participants from the introductory course in the current study may have had a closer social proximity than the groups used in Bickel et al.'s (2012) study. Additionally, our group context discounting assessment differed from the traditional group context (i.e., "me-we") assessment. Traditionally, "me-we" discounting provides the assumption that individuals are responding for hypothetical rewards for themselves and a group of anonymous individuals. However, in order to assess the social cohesiveness of our group foraging task (i.e., introduction to behavioral science students), the assumptions were adapted to include classmates in the group context. These differences in the group context assessment may account for the inconsistencies between studies.

There was a similar range of values for both the individual and group context delay discounting assessments which allowed for comparison between the metrics, showing a statistically significant correlation between both the individual and group context delay discounting assessments.

There were a range of values and categories for the competitiveness and social values orientation assessments, respectively, allowing for comparisons between these metrics.

Ideal Free Distribution Theory

Group foraging was described by the IFD theory, accounting for up to 99.91% of the variance in the data. Undermatching was observed, suggesting that changes in the number of individuals at a resource site were less extreme than changes in the available resources at that site. For each condition, as trials progressed, the distribution of participants got closer to ideal matching. That is, as participants experienced resource allocation in each condition, they

distributed themselves in a way that closely matched the proportion of available resources. This finding is consistent with past research, in that as participants experience the contingencies associated with a resource site selection, and are able to freely switch between resource sites within a trial, their distribution was better accounted for by the IFD theory (e.g., Madden et al., 2002). Additionally, as seen in Sokolowski et al. (2015), there was a high degree of correspondence between the average observed and predicted number of individuals selecting each resource site across the last five trials of each condition ($R^2 = .9991$).

The probability of switching resource sites, as defined by the proportion of individuals that switched resource sites following trials of varying point earnings, followed a similar pattern as found in past research (i.e., Critchfield and Atteberry, 2003; Madden et al., 2002). Participants that experienced lower point values relative to other resource sites were more likely to switch resource sites, while individuals that experienced medium point values relative to other resource sites tended to stay. The “big-win” pattern of responding, wherein individuals that earned relatively high point values relative to the other resource site, had an increased likelihood of switching sites.

Critchfield and Atteberry (2003) investigated the relationship between delay discounting and individual success in a group foraging task, hypothesizing that individuals that demonstrate steeper discounting would perform worse than individuals that demonstrate shallower discounting. Results from their study showed more impulsive participants tended to choose the lean patch more often, select the worse of the two resource sites more often, switch more often between resource sites, and earn fewer overall points, while compared to the other more self-controlled participants. Despite the same rationale for studying the relationship between delay discounting and the IFD theory, the current results slightly differ. In our study, there was a

significant positive correlation between individual discounting and total points earned, suggesting that the more impulsive individuals (as defined by steeper discounting) earned more overall points. Additionally, a multiple regression analysis showed a predictive negative correlation between total points earned for individual discounting, and the proportion of trials switched, and a predictive positive correlation between total points and scores on the competitiveness index, while controlling for all other assessments. However, despite these differences in the obtained results between these studies, it should be noted that there were differences in the procedures used. For instance, our study employed two empirically validated discounting assessments; a standard 27-item MCQ assessment and an adapted group-context assessment (i.e., Kirby et al., 1999; Charlton et al., 2013). Additionally, in Critchfield and Atteberry's (2003) group foraging task, participants were not allowed to switch within trials. During the current study, participants were allowed to freely switch between resources sites within a 15-second trial. As past research has shown, experimental manipulations to the ability to switch within a trial, the amount of feedback provided, and other procedural variations (e.g., the ability to talk, free-operant vs. discrete trial arrangement) all result in varying levels of conformity to the IFD theory (e.g., Critchfield & Atteberry, 2003; Madden et al., 2002; Sokolowski et al., 2015; Kraft & Baum, 2001). Therefore, the difference in experimental arrangements could have accounted for the differences in findings between the current study and Critchfield & Atteberry (2003).

Despite finding a statistically significant positive correlation between standard discounting and total points earned, and a multiple-regression analysis indicating a predictive correlation between group context discounting and the proportion of switches, there may be other assessments or processes that could better account for the IFD performance data. These data may

support the notion that a single pattern of responding or assessment may not easily explain performance in this group foraging task (Critchfield & Atteberry, 2003).

These data suggest that there is variation in individual choice patterns while operating in a group foraging context. That is, despite individuals operating under the same group foraging contingencies, there is variation in their individual performance such that some participants maximize their earned resources while others earn relatively few total resources. Understanding this variability through psychological and behavioral assessments may help us understand why organisms are more or less sensitive to group contingencies.

Future research could investigate other behavioral processes, alone or in combination, to see whether there are better predictors of performance in the group foraging task. Additionally, the effects of group placement are an avenue for future research. That is, to date, group placement in IFD tasks have been largely arbitrary. However, it may be that because performance in a group foraging task is dependent on both the available resources and the other foragers, the arrangements of groups could influence individual performance. For instance, after identifying the correlation between standard discounting and total points earned, future research could compare performance between highly impulsive groups, more self-controlled groups, or groups that are a mix of more and less impulsive individuals. By better understanding how and why individuals perform in competitive group contexts, and by understanding the interactions when group placement is a variable, we could better inform group placement in societal contexts (e.g., military settings, work settings, school settings) and maximize earned resources.

In the group foraging experimental arrangement, manipulations of resource availability resulted in proportional changes in the number of individuals at each resource site. These data supported the IFD theory, suggesting that by changing resource availability (e.g., amount,

quality, frequency of delivery), there would be changes in the allocation of individuals at these resource sites. Although the group foraging task represents a simplistic paradigm, if these results are conceptually scaled up, it suggests that the theory could be applied to the built environment. For instance, in areas that have fewer resources allocated to positive outlets (e.g., libraries, parks, school programs, athletics), and more resources allocated towards negative outlets (e.g., gang activity, unhealthy foods, drugs), we will likely see, a higher proportion of individuals sampling the negative outlet resource sites. However, as suggested by the IFD theory, by manipulating the availability of resources there will be corresponding changes in the distribution of individuals, thus influencing the likelihood that these individuals sample negative outlets.

There are a few potential limitations that should be noted. As described in the Method section, data were obtained using both paper-pencil self-recorded methods and the electronic automated iClicker software. Following the collection of data, there were unanticipated issues associated with each data collection method. Paper-pencil data demonstrated inaccurate records of point values and resource site selections, but each trial was filled in for each participant. Conversely, the automated iClicker software recorded accurate records of point values and resource site selections, but there were missing data for some participants. Presumably, this was because either the software did not record a response from a participant, or the participant did not make a response (but recorded it on their data sheet). Therefore, the data from both the paper-pencil and iClicker software were plotted and compared (see figure 3), demonstrating a statistically significant correlation between these values ($r(145) = 0.751, p < .0001$). Additionally, a best-fit line was also plotted ($y = .913X + 2.686$), with an R^2 value of .848. Outliers that were identified were excluded from the correlational and best-fit line analyses, but are plotted as red dots on figure 3. The electronic iClicker data were used throughout all analyses because they

were automated, eliminated self-report errors, and were used for immediate feedback during the group foraging task.

Another potential limitation is that the number of participants that completed the online survey did not match the number of participants that completed the in-class group foraging task. Because these tasks were offered as extra credit options, they were not required and thus individuals could opt out of one or both of the research activities. However, given the large sample sizes of each aspect of the current study, there were enough participants that completed both the in-class and online tasks to warrant statistical analyses. Any data that were used to compare the online survey results with the group foraging task were only for participants that completed both components of the study.

Overall, the current study sought to investigate whether several commonly used behavioral and psychological assessments were predictive of individual performance in a large-scale group foraging task. Notably, individual competitive success (i.e., total points earned in the group foraging task) was statistically significantly predicted by the proportion of trials switched, individual delay discounting, and total competitiveness index score, when controlling for all other assessments. As a group, the distribution of participants was well described by the IFD theory.

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Table 1.

Percentile Rank	Extra Credit Earned
100-75	1.50%
74-50	1.25%
49-25	1.00%
24-0	0.75%

Table 2.

Condition	Points A	Points B	Ratio
1	80	40	2:1
2	20	100	1:5
3	100	20	5:1
4	40	80	1:2
5	60	60	1:1
6	20	100	1:5

Table 3.

	Competitiveness Score	Group Discounting	Individual Discounting	Total Points Earned	Proportion of Trials Switched
Competitiveness	---				
Group Discounting	0.836	---			
Individual Discounting	-0.062	0.710***	---		
Total Points Earned	0.144	0.023	0.186*	---	
Proportion of Trials Switched	-0.089	-0.140	-0.051	-0.121	---

* $p < .05$ ** $p < .01$ *** $p < .001$

Table 4.

DV = Total Points	β	SE	<i>t</i>	<i>p</i>
Intercept	68.422	1.476	46.342	.000
Prop. Trials Switched	-6.336	1.994	-3.177	.002
Competitiveness	.053	.023	2.301	.023
Individual Discounting	-.450	.209	-2.152	.034
Group Context Discounting	.303	.191	1.585	.116
Prosocial SVO				
Individualistic SVO	-.121	.444	-.272	.786
Mixed SVO	.407	.867	.469	.640
Competitive SVO	-.669	.622	-1.077	.284

$R^2 = .187$ (Adj. $R^2 = .134$)

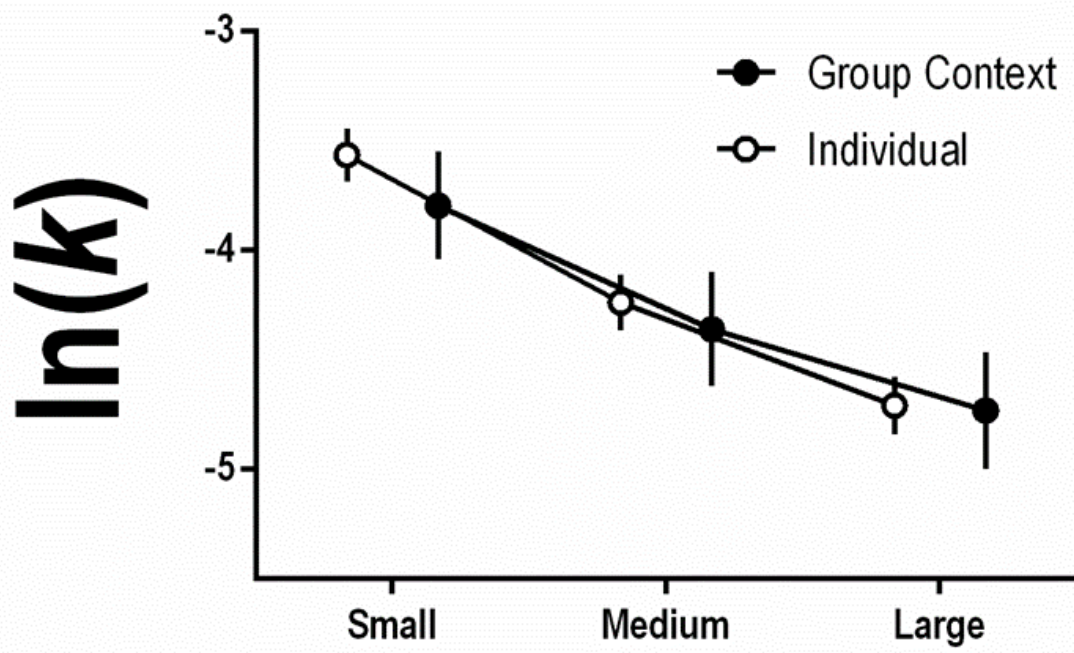


Figure 1.

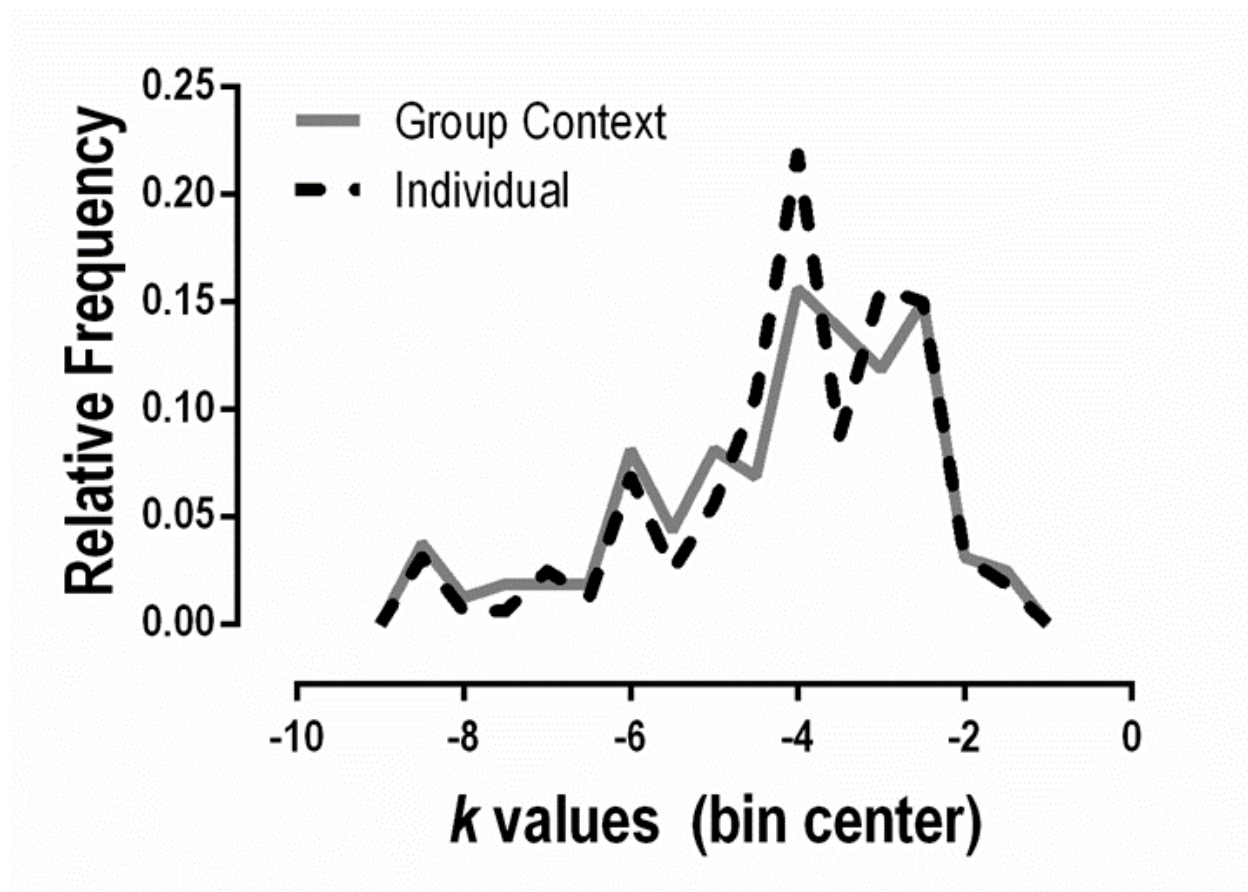


Figure 2.

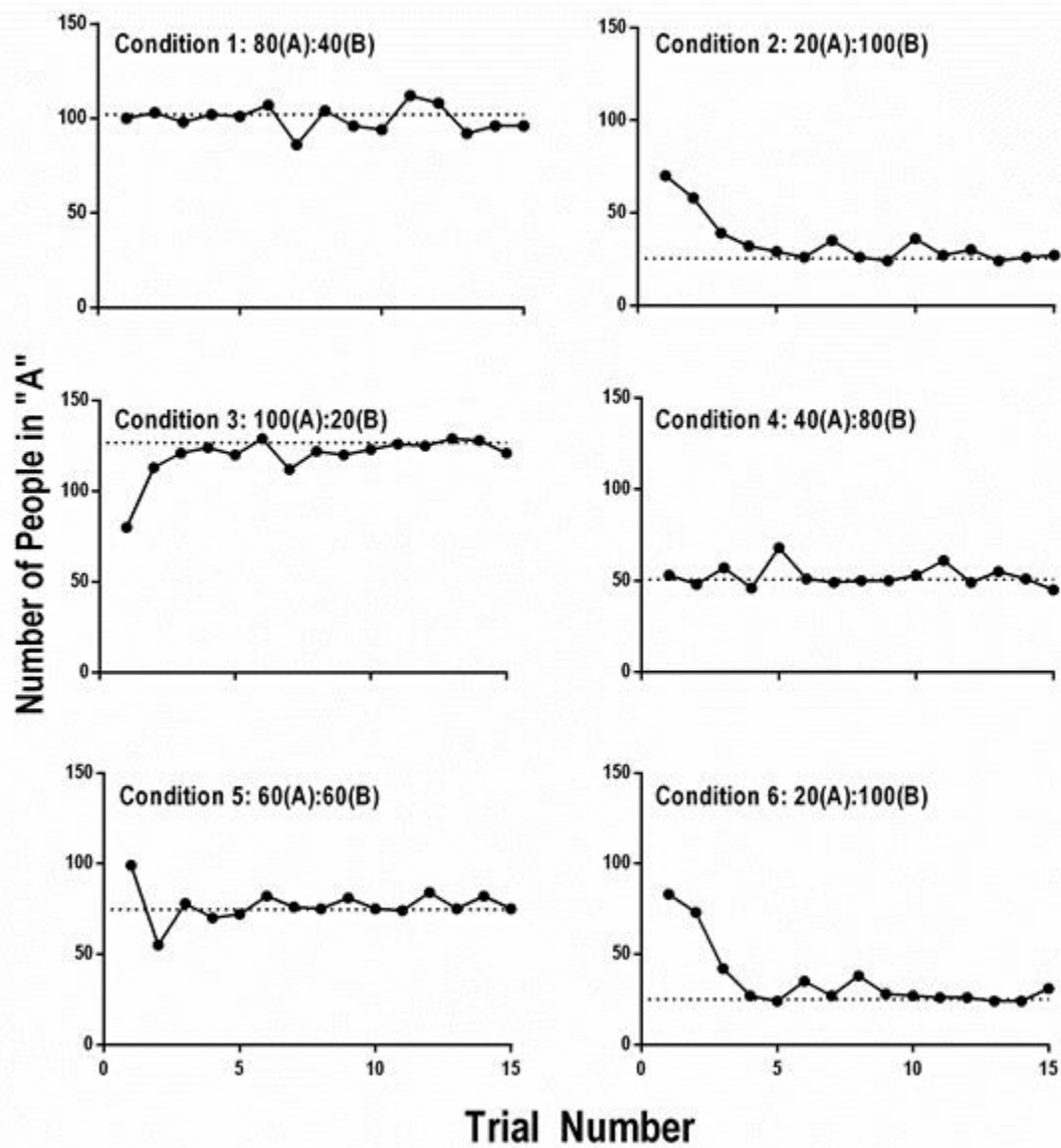


Figure 3.

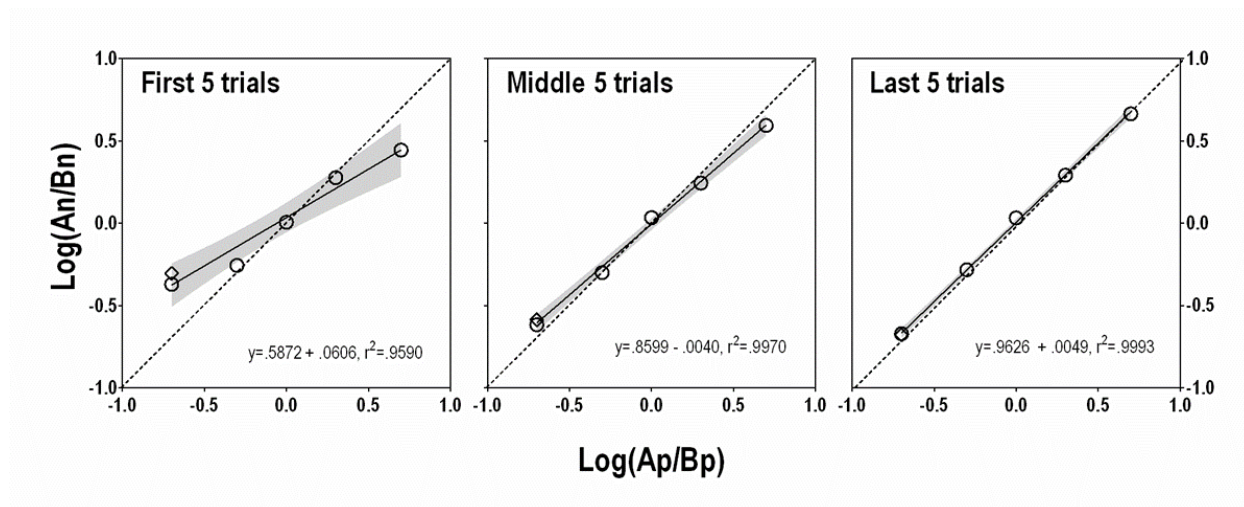


Figure 4.

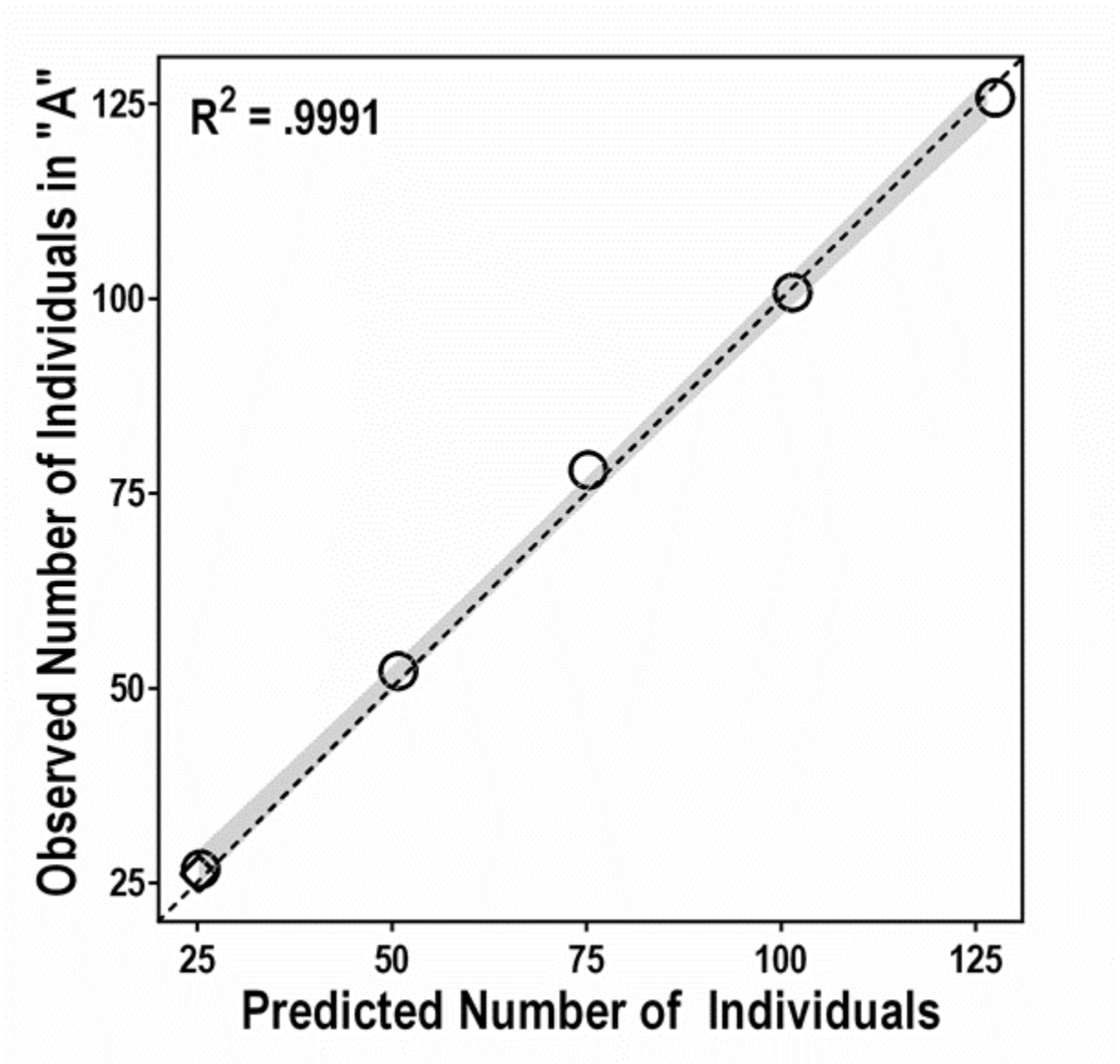


Figure 5.

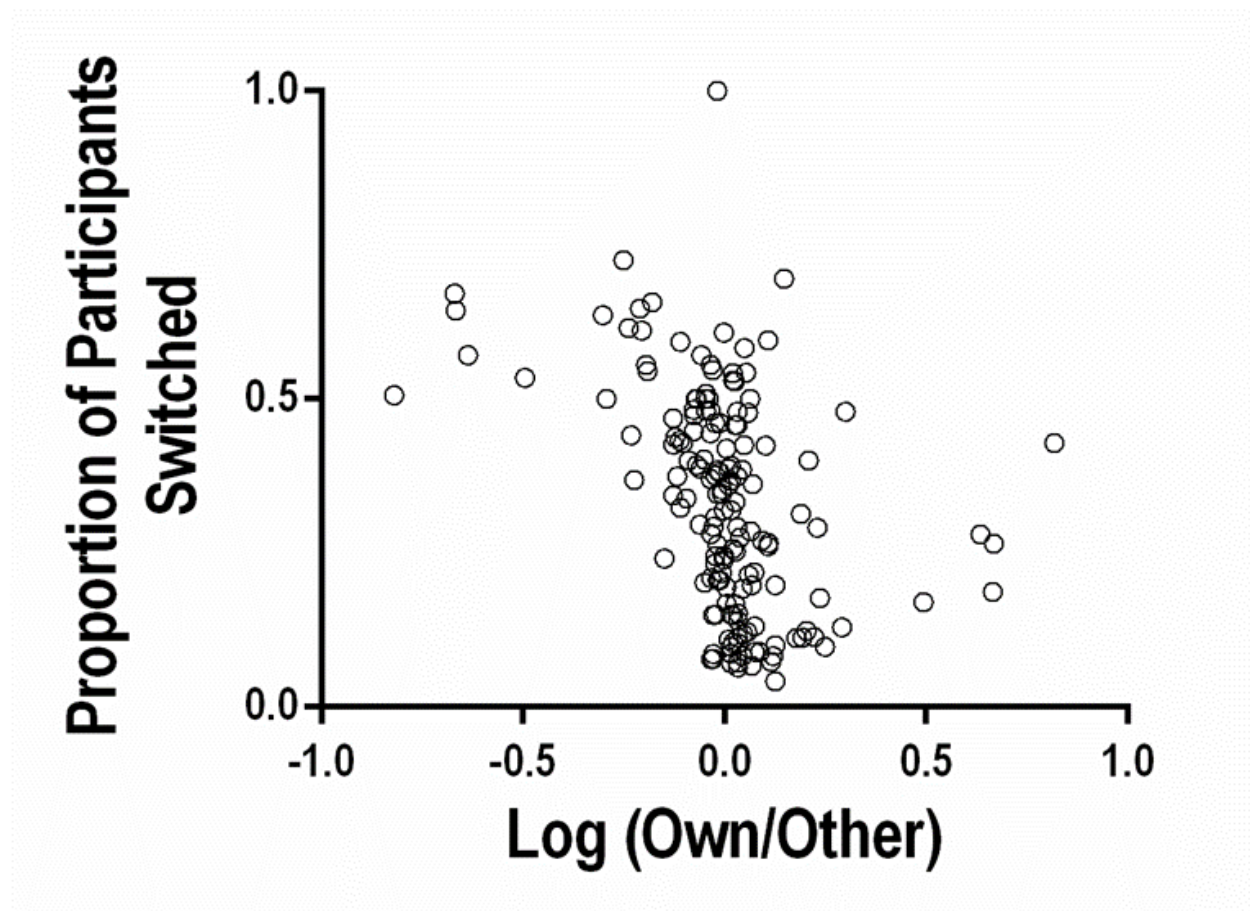


Figure 6.

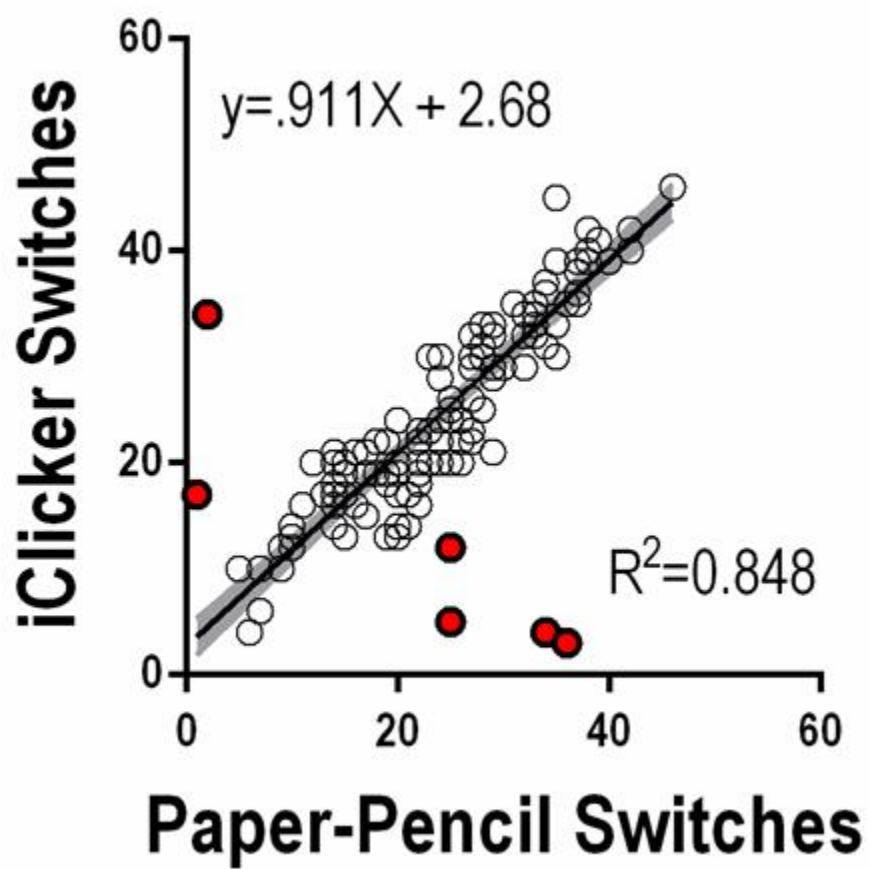


Figure 7.

Appendix A

Ideal Free Distribution Theory: Assessing Behavioral Predictors for Performance in a Group Foraging Task

The Department of Applied Behavioral Science at the University of Kansas supports the practice of protection for human subjects participating in research. The following information is provided for you to decide whether you wish to participate in the present study. You should be aware that even if you agree to participate, you are free to withdraw at any time without penalty.

We are conducting this study to better understand the interactions between decision making processes and group foraging. This will entail your completion of two separate tasks: 1) an online survey consisting of demographic questions and three decision making assessments, and 2) your participation in an in-class group foraging activity. Your participation is expected to take approximately 20 minutes to complete for the survey, and roughly 1 hour of in-class time for the group foraging task. The content of the survey and foraging task should cause no more discomfort than you would experience in your everyday life.

During the group-foraging task, you will be asked to make a series of choices between two resource sites. There will be a certain amount of points available for each resource site that you will split evenly with the other individuals that choose that site. If you choose resource site "A", you will split the points available with the number of individuals in this site. For example, if there are 50 available points in resource site "A" for that trial, and there are 100 individuals at resource site "A", then you will each earn (50pts/100ind) .5pts. This process will repeat for 90 trials.

Participants will be compensated with extra-credit for completing the survey and foraging task (up to 2% of your overall grade). Additionally, we believe that the information obtained from this study will help us gain a better understanding of how individual's decision making relates to performance in a group foraging activity. Your participation is solicited, although strictly voluntary. Your name will be associated with your iClicker ID#, however, this information will only be accessible by the instructors of the ABSC 100 course (PI, faculty supervisor, research assistant). Your identifiable information will not be shared unless (a) it is required by law or university policy, or (b) you give written permission. All data collected will be paired with your iClicker ID#. Your responses will be stored in the researchers locked filing cabinet in a locked office space and on password-protected encrypted hard drives. It is possible, however, with internet communications, that through intent or accident someone other than the intended recipient may see your response.

Percentile Rank	Extra Credit Earned
100-75	1.50%
74-50	1.25%
49-25	1.00%
24-0	0.75%

Your participation will be compensated with .5% extra credit added to your final course score from ABSC 100 for completion of the survey, and up to 1.5% for the group foraging task. The breakdown of extra credit is presented

below and the percentile rank is dictated by performance during the group foraging task.

If you would like additional information concerning this study before or after it is completed, please feel free to contact us by phone or email.

Completion of the surveys indicates your willingness to take part in this study and that you are at least 18 years old. If you have any additional questions about your rights as a research participant, you may call (785) 864-7429 or write the Human Subjects Committee Lawrence Campus (HSCL), University of Kansas, 2385 Irving Hill Road, Lawrence, Kansas 66045-7563, email irb@ku.edu.

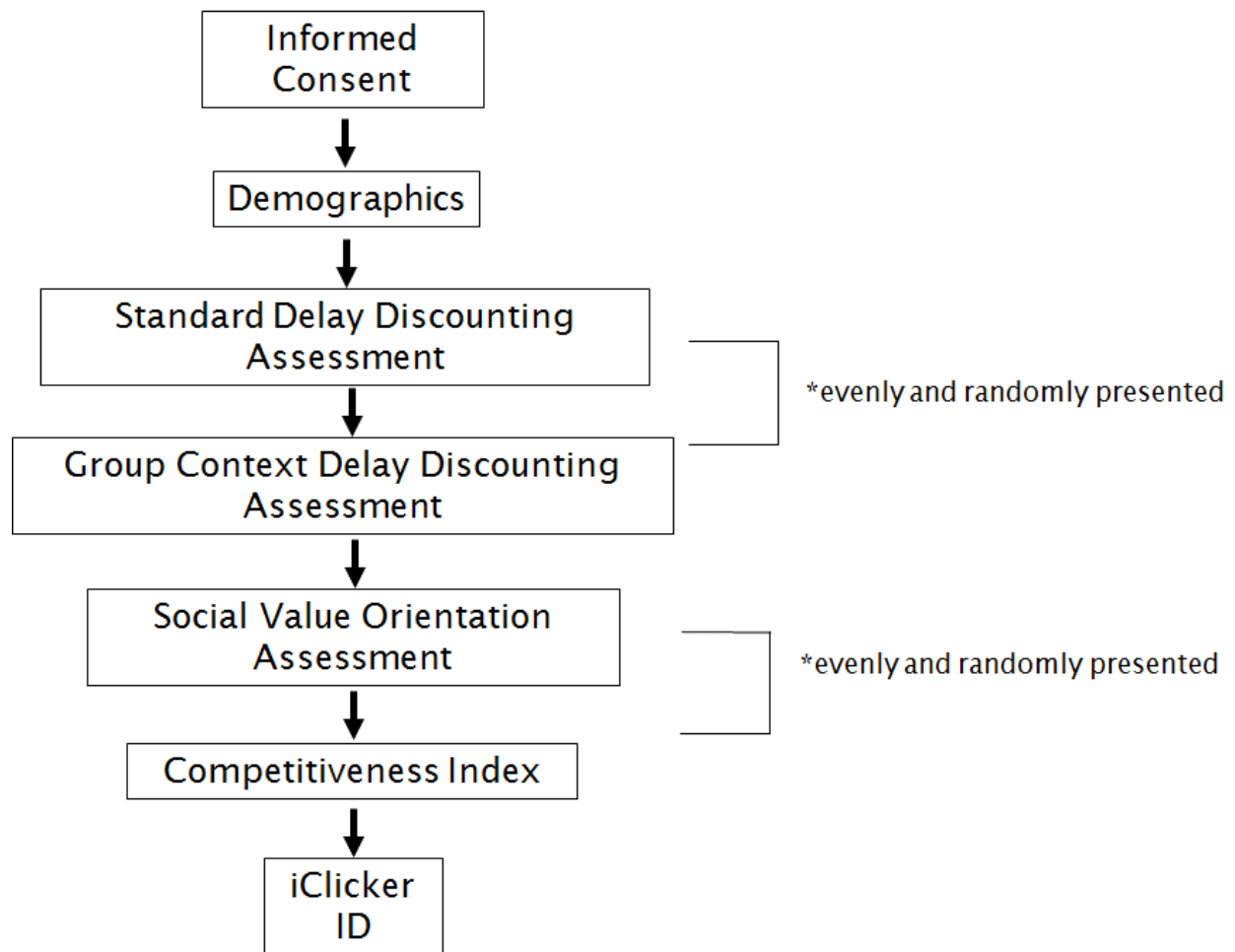
Sincerely,
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Appendix B



Appendix C

For each of the next 27 choices, please mark which hypothetical reward you would prefer: the smaller reward today, or the larger reward in the specified number of days. While you will not actually receive the rewards, pretend you will actually be receiving the amount you indicate and answer honestly.

Which would you rather have?

- ☐ \$54, right now
- ☐ \$55, 117 days from now

Which would you rather have?

- ☐ \$55, right now
- ☐ \$75, 61 days from now

Which would you rather have?

- ☐ \$19, right now
- ☐ \$25, 53 days from now

Appendix D

Imagine you must make decisions that affect you and 9 other classmates in ABSC 100. For each of the next 27 choices, please mark which hypothetical reward you would prefer: the smaller reward today, or the larger reward in the specified number of days. However, the choices that you will make will benefit you and 9 other classmates in ABSC 100. While neither you nor each of the classmates will not actually receive the rewards, pretend that you all will actually be receiving the amount you indicate and answer honestly as if the rewards were real.

Which would you rather have?

- ☐ \$54, for you and 9 other ABSC 100 students right now
- ☐ \$55, for you and 9 other ABSC 100 students in 186 days

Which would you rather have?

- ☐ \$55, for you and 9 other ABSC 100 students right now
- ☐ \$75, for you and 9 other ABSC 100 students in 61 days

Which would you rather have?

- ☐ \$19, for you and 9 other ABSC 100 students right now
- ☐ \$25, for you and 9 other ABSC 100 students in 53 days

Appendix E

An Instrument to Measure Social Value Orientation

In this task we ask you to imagine that you have been randomly paired with another person, whom we will refer to simply as the "Other." This other person is someone you do not know and that you will not knowingly meet in the future. Both you and the "Other" person will be making choices by circling either the letter A, B, or C. Your own choices will produce points for both yourself and the "Other" person. Likewise, the other's choice will produce points for him/her and for you. Every point has value: The more points you receive, the better for you, and the more points the "Other" receives, the better for him/her.

Here's an example of how this task works:

	A	B	C
You get	500	500	550
Other gets	100	500	300

In this example, if you chose A you would receive 500 points and the other would receive 100 points; if you chose B, you would receive 500 points and the other 500; and if you chose C, you would receive 550 points and the other 300. So, you see that your choice influences both the number of points you receive and the number of points the other receives.

Before you begin making choices, please keep in mind that there are no right or wrong answers—choose the option that you, for whatever reason, prefer most. Also, remember that the points have value: The more of them you accumulate, the better for you. Likewise, from the "other's" point of view, the more points s/he accumulates, the better for him/her.

For each of the nine choice situations, circle A, B, or C, depending on which column you prefer most:

(1) You get	A	B	C	(6) You get	A	B	C
	480	540	480		500	500	570
Other gets	80	280	480	Other gets	500	100	300
(2) You get	A	B	C	(7) You get	A	B	C
	560	500	500		510	560	510
Other gets	300	500	100	Other gets	510	300	110
(3) You get	A	B	C	(8) You get	A	B	C
	520	520	580		550	500	500
Other gets	520	120	320	Other gets	300	100	500
(4) You get	A	B	C	(9) You get	A	B	C
	500	560	490		480	490	540
Other gets	100	300	490	Other gets	100	490	300
(5) You get	A	B	C				
	560	500	490				
Other gets	300	500	90				

Note. Participants are classified when they make 6 or more consistent choices. Prosocial choices are 1c, 2b, 3a, 4c, 5b, 6a, 7a, 8c, 9b; individualistic choices are 1b, 2a, 3c, 4b, 5a, 6c, 7b, 8a, 9c; and competitive choices are 1a, 2c, 3b, 4a, 5c, 6b, 7c, 8b, 9a.

Appendix F

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I like competition.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am a competitive individual.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I enjoy competing against an opponent.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I don't like competing against other people.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I get satisfaction from competing with others.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I find competitive situations unpleasant.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I dread competing against other people.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I try to avoid competing with others.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I often try to out perform others.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I try to avoid arguments.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I will do almost anything to avoid an argument.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I often remain quiet rather than risk hurting another person.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I don't enjoy challenging others even when I think they are wrong.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
In general, I will go along with the group rather than create conflict.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Appendix G



Appendix H

Cond. 1			Last 4 digits of KU I.D.:	
Trial #	Resource Selection	# of Points Earned	# of People in "A"	# of People in "B"
1	A B			
2	A B			
3	A B			
4	A B			
5	A B			
6	A B			
7	A B			
8	A B			
9	A B			
10	A B			
11	A B			
12	A B			
13	A B			
14	A B			
15	A B			

Example Trial

- Step 1: iClicker quiz will open for 15 seconds and you will be prompted to select either “A” or “B”.

- Step 2: You will record which resource site you selected on your data sheet.

Trial #	Resource Selection
1	A B

- Step 3: You will be provided with the number of points earned for each resource site, and the number of people at each resource site.

Condition	Trial	Pts/person "A"	Pts/person "B"	# of People in "A"	# of People in "B"
1	1	2.96	0.86	27	46
	2				
	3				
	4				
	5				
	6				
	7				
	8				
	9				

- Step 4: You will write down the number of points you earned, as well as the number of people that were in “A” and “B”.

Condition	Trial	Pts/person "A"	Pts/person "B"	# of People in "A"	# of People in "B"
1	1	2.96	0.86	27	46
	2				
	3				
	4				
	5				
	6				
	7				
	8				
	9				

Condition 1			Last 4 digits of KU I.D.:	
Trial #	Resource Selection	# of Points Earned	# of People in "A"	# of People in "B"
1	A B	.86	27	46

- Step 5: Another trial will begin and you will make another choice between “A” and “B”.

The number of points allocated to the “A” zone and “B” zone has now changed. It is up to you to determine the best way to earn points.

Appendix K

